AD NUMBER
ADB336590
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AUTHORITY
USAF AFRL/711 HWP/OMCA (STINFO) ltr dtd 5 Oct 2011

Impact of Workstation Accommodation on Fatigue and Performance

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ABSTRACT

INTRODUCTION*: The development of a man-machine interface with component adjustability for unmanned aerial vehicle and other remote workstations that the Air Force employs is important and necessary due to the size variability of the operators. In order to provide the range of operators an optimum interface, ergonomic principles must be applied to design for the adjustability that is required to simultaneously prevent discomfort and fatigue and promote performance. Appropriate performance measures must then be employed to delineate between optimal and sub-optimal workstation configurations.* ***METHODS****: Thirty male and female subjects participated in this study, which examined the impact of accommodation of a dual-monitor computer workstation. As a measure of performance, subjects performed a split-attention computer task. Surface electromyography was collected on the left and right trapezius and deltoid muscles. Cerebral oxygenation levels were monitored via non-invasive near-infrared surface sensors placed on the right and left sides of the forehead. Subjective comfort levels were recorded via a questionnaire at the start, middle, and end of the session.* ***RESULTS****: Trends in performance, oxygenation, and comfort corresponded with workstation configuration. Median frequency analyses of the electromyography signal gave an indication of muscular fatigue levels that were evident in the task-controlling arm.* ***CONCLUSIONS****: For UAV control station designs, it is important to consider all sizes of potential users when designing for adjustability. In addition, designs must take into consideration the effect of synergistic positioning of all components of the workstation on all of the operator's bodily components. The cognitive implications of the mission will go hand in hand with the physical ergonomics, perhaps more noticeably for longer missions.*

1.0 INTRODUCTION

Due to the exhibition of military effectiveness in recent missions in Iraq, Afghanistan and Kosovo, the potential for employing unmanned aerial vehicles (UAV)s in increased and non-traditional operations above and beyond surveillance missions is gaining interest and support [1]. With the projected procurement of UAVs in the military inventory jumping from 90 vehicles in 2000 to 249 by the end of 2007 [1], optimizing the operator-machine interface is of utmost importance. Although several efforts are underway to merge the operator's capabilities with the advanced technology and increased tasking demands of UAVs within the control station environment [2,3,4], it is also important to consider the physical implications of the operator's interactions within this environment, especially with the potential of a control station design evolution.

Parakkat, J.; Pellettiere, J.; Harrison, C. (2006) Impact of Workstation Accommodation on Fatigue and Performance. In *Human Factors of Uninhabited Military Vehicles as Force Multipliers* (pp. P5-1 – P5-12). Meeting Proceedings RTO-MP-HFM-135, Poster 5. Neuilly-sur-Seine, France: RTO. Available from: http://www.rto.nato.int/abstracts.asp.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **01 DEC 2006**	2. REPORT TYPE **N/A**	3. DATES COVERED **-**

4. TITLE AND SUBTITLE **Impact of Workstation Accommodation on Fatigue and Performance**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air Force Research Laboratory/Biomechanics Branch Building 824, 2800 Q Street Wright-Patterson AFB, OH 45433-7947 USA**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR’S ACRONYM(S)
	11. SPONSOR/MONITOR’S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Distribution authorized to U.S. Gov’t. agencies and their contractors; (Foreign Government Info; Dec 2006). Other requests shall be referred to (Research and Technology Organization, BP 25, F-92201 Neuilly-sur-Seine Cedex, France.).

13. SUPPLEMENTARY NOTES
See also ADM202405., The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**SAR**	**12**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

As far back as the 1970's, studies have indicated that the biomechanical and ergonomic risk factors for musculoskeletal disorders associated with computer workstations are directly related to prolonged sitting in unhealthy postures [5,6]. However, only within the past ten years have the psychosocial risk factors of work with computer workstations been recognized in terms of their physical effect on the operator. In the typical office setting, psychosocial risk factors associated with workstations include workload, work pressure, fast work pace, high demand, low work control [7]. In the military-specific case of UAV control stations these same factors are very much present, perhaps even at an exacerbated level due to the increased situational awareness demands, mission criticality, and inadequate operator adaptability to continuously growing workload demands due to technological advancements. Psychosocial stress has been shown to manifest itself physically by compounding on the biomechanical and ergonomic risks to ultimately result in musculoskeletal problems. Although operational time of UAV missions may allow for sufficient musculoskeletal recovery between operations or within an operation, the potential for the additive effect of cognitive and physical stress leading to measurable levels of decreased operator performance is of significant concern.

Designing for control station component adjustability allows for a better fit for the operator. However, without effective mission performance no definition of fit can be considered meaningful. Therefore, improved fit can be seen as an avenue of maximizing the mission effectiveness of UAV operators over time by improving the usability of the equipment, reducing fatigue, and reducing mishap due to poor accommodation. The effort to understand the cumulative effects of cognitive and physical stress as moderators on performance in the office workstation environment is lacking, perhaps due to the typical non-critical nature of the work. However, this effort is of critical importance within the UAV control station environment when considering the significance behind the prevention of mission failure and monetary loss. Evidence of control station ergonomic evaluations is lacking in the literature and is therefore addressed in this study. The present research focuses on the biodynamic impact of anthropometric accommodation of a dual-monitor computer workstation on an operator's performance. As indicated in Figure 1, it is hypothesized that there exists a time-dependency of the effect of accommodation on the level of performance. If biomechanical fatigue occurs prior to measurable levels of cognitive decrement, objective measures of physiological responses may help to predict declining operator mission effectiveness.

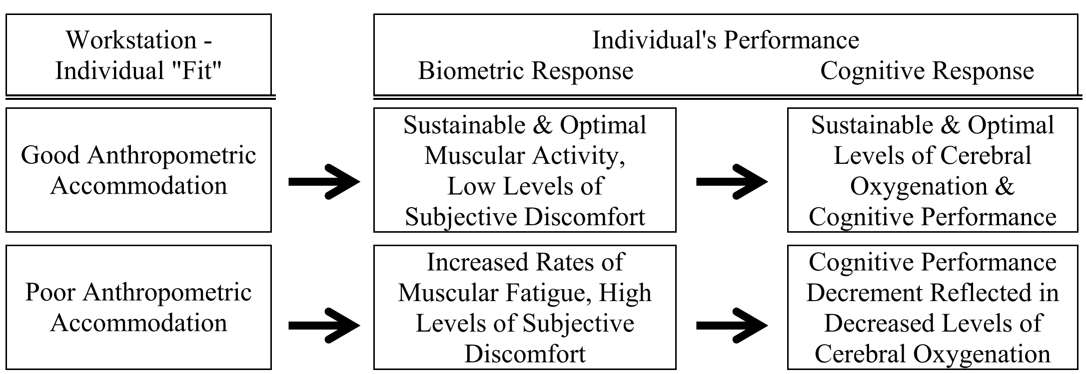

Figure 1: Hypotheses on multi-level effect of anthropometric accommodation in control stations

In the current study two extreme workstation configurations were examined, including one that provided good accommodation based on current ergonomic guidelines and one that provided poor accommodation but still allowed for operational performance. The difference between the configurations was drastic and it was hypothesized that monitoring muscle fatigue, localized oxygenation levels, and results of a cognitive task would be appropriate performance measures to delineate between workstation configurations.

As a measure of fatigue, quantitative muscle activity data and percent oxygen saturation data were collected using a surface electromyography system and a near-infrared oxygen sensing system, respectively, while the subject was seated at the workstation. To evaluate cognitive performance as a function of the workstation settings, a cognitive task analysis was performed by administering a split-attention, multi-task battery. Subjective data were collected by completion of comfort surveys before, during and after each test. In addition to testing the hypotheses, this study aimed to determine if the above-mentioned performance measures were adequately sensitive to distinguish between two extremely different workstation configurations so that further studies can narrow in on the optimization of configuration accommodation for UAV control stations and can aid in better defining the design parameters above and beyond the current military standards [8].

2.0 METHODS

2.1 Subjects

Thirty civilian subjects completed all test cells in this study. There were 15 males aged 18-51 years and 15 females aged 18-44 years who participated. All subjects were informed of the content and risk of the experiment in advance and gave written consent to voluntarily participate. The male subject body height and body mass were 175.5 ± 7.8 cm and 77.6 ± 16.3 kg (mean ± SD), respectively. The female subject body height and body mass were 167.0 ± 6.2 cm and 71.9 ± 23.6 kg (mean ± SD), respectively.

2.2 Experimental Protocol

A total of three experimental sessions comprised testing for one subject. During the first session, full-body anthropometric measurements were taken of the subject using traditional and computer scanning tools [9]. Key anthropometric measurements were used to adjust the workstation to each individual. Additionally, subjects were trained on a multi-attribute cognitive task battery until scores reached a plateau that was indicative of no further effects of learning on the test scores.

During the second and third sessions, subjects were exposed to one of two workstation configuration settings. The two settings were randomly assigned to either the second or third session. The experiment consisted of an 80-minute session during which the subject performed the cognitive task battery continuously at the pre-set workstation configuration. Prior to the experiment, the maximum voluntary contraction (MVC) was taken of the right deltoid and right trapezius muscles using a static contraction testing device that consisted of a load cell to which the subject’s right arm was tethered and an output display. MVC force output from the load cell was displayed and recorded as the subject abducted the arm to the level of the shoulder. Based on the MVC force output, 70% MVC force was calculated. Subjects performed a 70% isometric contraction in the same test device used for the MVC prior to the experiment, at the mid-point of the experiment and at the end of the experiment in order to give a time history of the fatigue effects of the experimental conditions. Surface electromyography (EMG) signals of the deltoid and trapezius were recorded during the contractions. In addition to electromyographic readings, cerebral oxygenation was monitored over the entire 80-minute session for a subset of the subjects (10 males, 9 females) and subjective comfort ratings were collected at the start, mid-point and end of the experiment.

2.3 Workstation Settings

The computer workstation is a dual-monitor fully adjustable workstation with two 20.5” x 16.25” (width x height) flat-panel monitors. Monitor height, depth, inter-distance, tilt, base rotation and screen rotation are adjustable. Keyboard height, depth, and tilt are adjustable. Chair height and depth, seat pan tilt, and backrest tilt are adjustable. The adjustable workstation was configured according to each individual’s anthropometric measurements and was adjusted such that the degree of fit was the same between individuals. Two workstation configurations were examined. One configuration, the good condition, was based on current ergonomic guidelines for proper computer workstation setups as outlined by the National Institute for Occupational Safety and Health (NIOSH), the National Institutes of Health (NIH), Human Factors and Ergonomics Society (HFES), and the Centers for Disease Control and Prevention (CDC) [10,11,12,13]. The second configuration, the poor condition, forced the user to assume postures that were outside of the range of acceptable ergonomic postures while seated at a workstation but still allowed for operational capability. For the current study, between the good and poor conditions the components that were adjusted include monitor height, inter-monitor distance, monitor tilt, keyboard height, and keyboard depth. Chair height and backrest tilt were adjusted to each individual but did not vary as a function of workstation configuration. Keyboard platform tilt remained level for all subjects for both conditions. The method used to calculate component adjustments based upon the anthropometric measurements is presented in Figure 2. In an attempt to understand postural adaptation to the workstation, the subject was free to situate his or her body to preference. To maintain a level of consistency among subjects, the only postural constraints placed on the subject were that the feet were to be placed flat on the floor and the wrist was not to be resting on the keyboard platform.

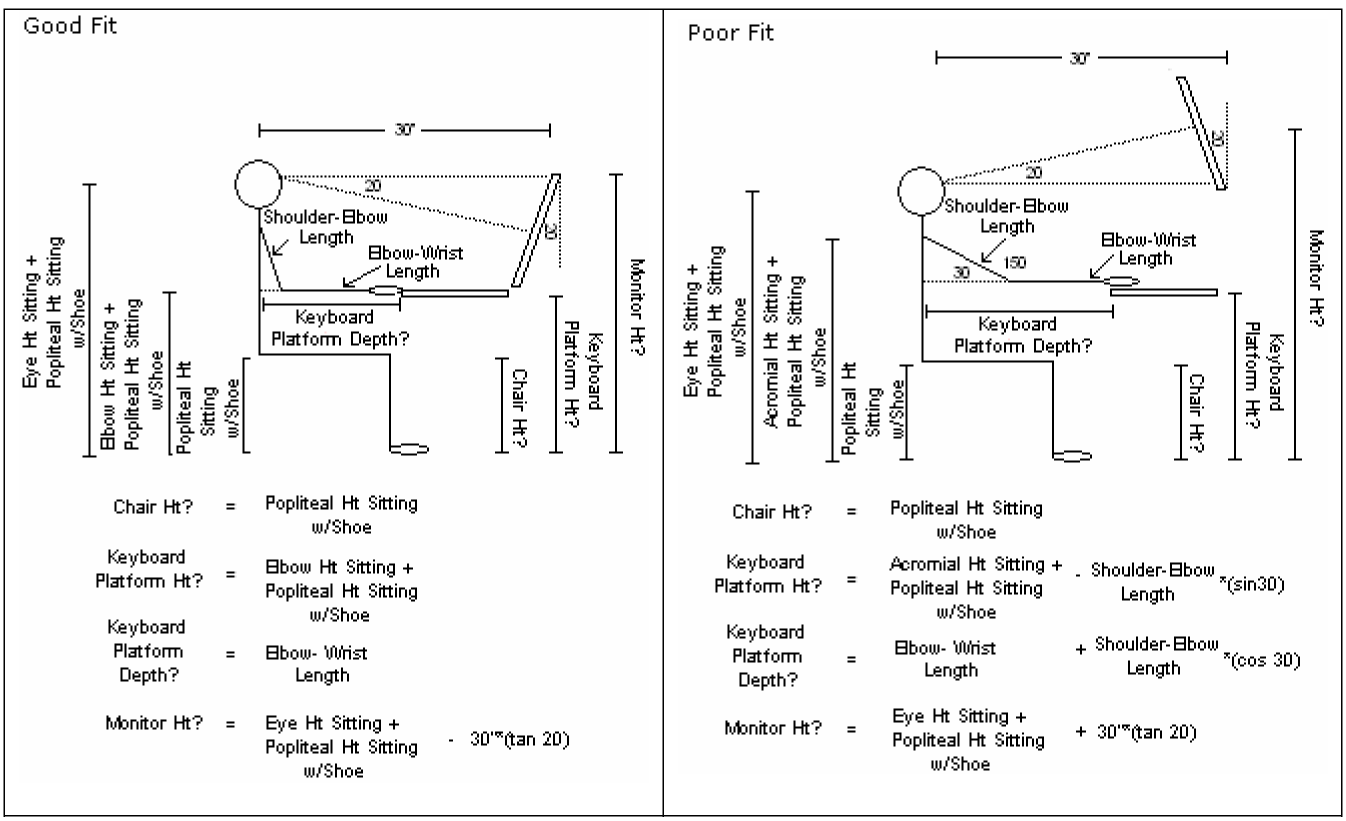

Figure 2: Workstation component adjustment calculation from anthropometric measurements

2.4 Electromyography

Approach: To evaluate muscle fatigue over the duration of the experimental session and to compare between workstation accommodation settings, the muscle activity of two upper extremity muscles was monitored and analyzed for fatigue. These muscles include: the right trapezius and the right deltoid.

The median frequency of the muscles was analyzed from the EMG signal collected using the DELSYS hand-held Myomonitor III data acquisition system. The median frequency was used as a means to determine whether muscular fatigue in the deltoid and trapezius muscles was induced due to the workstation settings. Two signal conditioning surface sensors with a contact dimension of 10 x 1.0 mm were used. The sensors required minimal skin preparation and, after being located via palpation, muscle sites were cleaned thoroughly with rubbing alcohol. Fatigue effects were calculated using well-established analysis techniques [14,15,16] via median frequency calculation of the EMG signals that were collected during the three 70% isometric contractions. A shift to a lower median frequency from the start to the middle to the end would indicate fatigue in the musculature as a result of performing the computer task at the workstation configuration.

2.5 Perceived Discomfort

Approach: To determine whether a correlation exists between fit and the perception of discomfort, subjective comfort levels for individual body parts was noted at the start, middle and end of data collection.

The subjective comfort survey required subjects to give feedback on their discomfort prior to exposure, during exposure and immediately after exposure to the experimental conditions. Subjects rated discomfort on a 10 point scale, where 1 was equivalent to no discomfort and 10 was equivalent to maximal discomfort. Subjects rated ten body regions: neck, shoulders, upper back, center back, lower back, upper arms, buttocks, thighs, knees and lower legs. Subjective ratings were evaluated and compared to the objective parameters.

2.6 Cognitive Task Battery

Approach: To evaluate performance degradation and differences between workstation accommodation settings, the composite score, dwell time, percent correct, and percent error on the cognitive task were recorded and analyzed.

A cognitive task battery created by Activity Research Services and called SynWin, short for Synthetic Work for Windows, was used to obtain objective performance data. The SynWin program configuration consists of four tasks to which the subjects were required to respond simultaneously and continuously for two 40-minute sessions. Two tasks were presented on the right computer monitor and the other two tasks were presented on the left monitor. The tasks include a memory task, an arithmetic task, visual monitoring, and auditory monitoring, and are controlled by a computer mouse. SynWin has successfully been used as a measure of cognitive performance in previous comfort evaluations [17,18] and has been used extensively at the Warfighter Fatigue Countermeasures Branch of the Air Force Research Laboratory.

2.7 Oximeter

Approach: To evaluate oxygen requirements over the duration of the experimental session and to compare between workstation accommodation settings, the percent oxygen saturation in the forehead was monitored on both the right and left sides on a subset of the participants.

The INVOS cerebral oximeter system (Somanetics, Troy, MI) was used to measure the cerebral oxygen saturation of the frontal lobes. The system uses near-infrared spectroscopy (NIRS) to non-invasively and continuously monitor changes in regional oxygen saturation, rSO_2, within a sample of blood in the brain. Two surface sensors were adhered to the skin of the subject's forehead. Readings were taken continuously at a rate of 5 samples/minute as the subject performed the cognitive task battery during both workstation configuration sessions.

2.8 Statistical Analysis

Mixed design analyses of variance were performed with the following dependent variables: median frequency of the deltoid and trapezius EMG signals, discomfort ratings, task performance score, and regional oxygen saturation. Within factors of the analyses were workstation condition (poor, good) and time (start, middle, end or session 1 for the first 40-minute session, or session 2 for the second 40-minute session). The between factor was gender. Subject was considered random. Post-hoc paired comparisons of workstation condition used the Bonferroni procedure of two-tailed t-tests with pooled error.

3.0 RESULTS

3.1 Muscular Fatigue

Contrary to the hypotheses, the results showed that the good workstation configuration elicited significantly higher levels of fatigue as the session progressed from the start for the deltoid muscle (p=0.0017). The change in median frequency for the poor workstation configuration, on the other hand, was not statistically different from the start to the middle to the end of the session. The change in median frequency for the trapezius muscle was also not significant for either configuration. A shift in the median frequency of the isometric contraction signal to lower frequencies over the test session is indicative of fatigue (Figure 3).

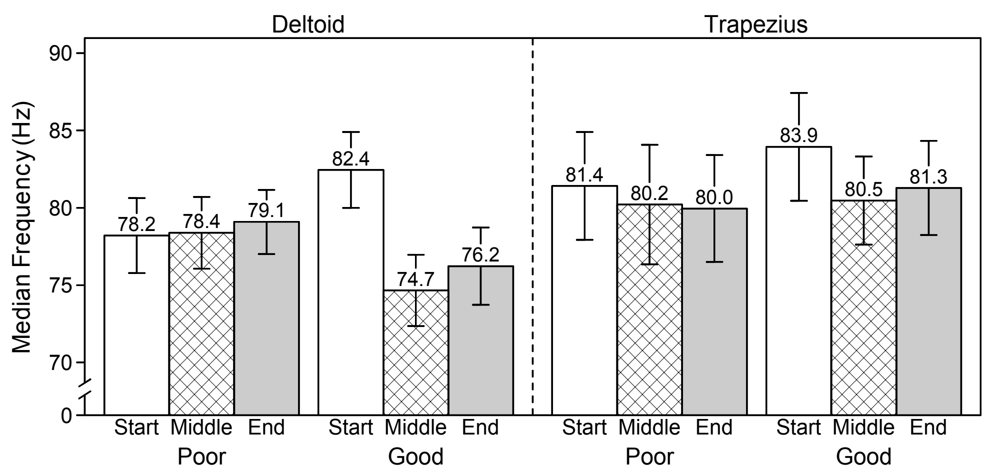

Figure 3: Muscular fatigue trends over time for the poor and good workstation configurations

3.2 Perceived Discomfort

Subjective levels of discomfort indicated that as the session progressed perceived discomfort increased significantly in the neck ($p=0.0001$), shoulder ($p=0.0005$), upper arms ($p=0.0002$), and upper back ($p=0.0040$) regardless of workstation configuration. However, the rate of increase of discomfort levels was higher in the poor workstation configuration as indicated in Figures 4 and 5. Ratings for the center back, lower back, buttocks, thighs, knees, and lower legs were excluded from the statistical analysis since the majority of the subjects gave a rating of 1 (no discomfort) for most if not all combinations of condition and time. Since the chair was adjusted to the seated height and comfort of each individual and remained constant for both configurations, it was expected that the effect on the lower extremities would be minimal or non-existent.

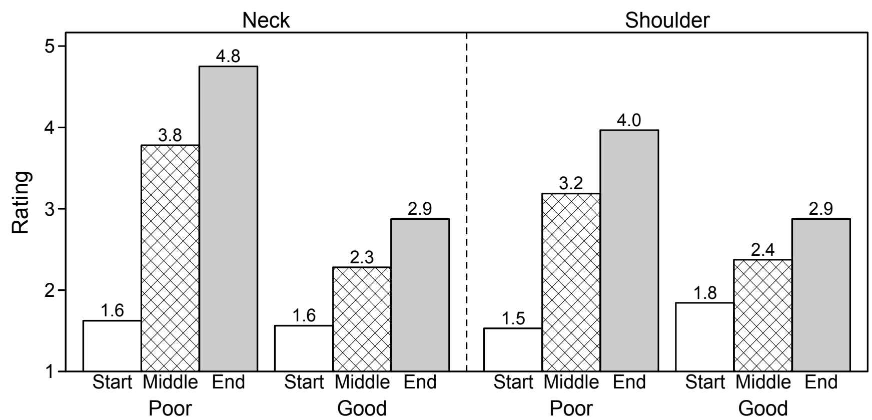

Figure 4: Subjective discomfort ratings over time for the poor and good workstation configurations for the neck and shoulder

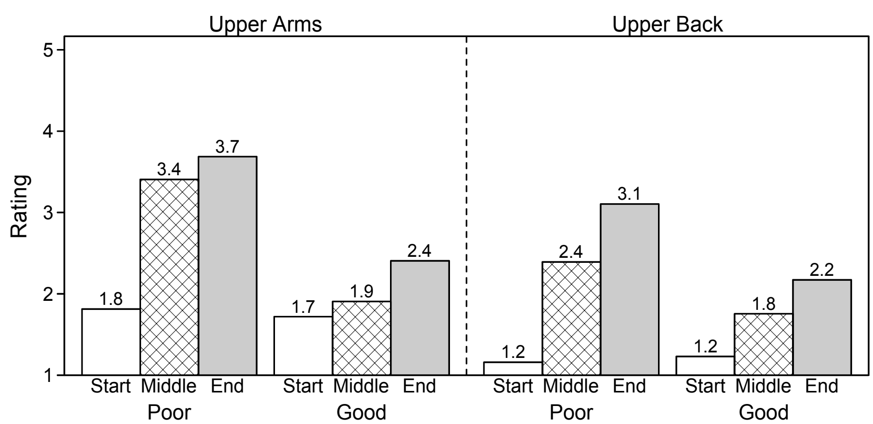

Figure 5: Subjective discomfort ratings over time for the poor and good workstation configurations for the upper arms and upper back

3.3 Task Performance

The multi-attribute task battery output a composite score computed from the individual task scores. The analyses indicated that there was a significant decrement in performance while at the poor workstation configuration (p=0.0152). However, from the first 40-minute session to the second 40-minute session there was no significant change in performance as time progressed (Figure 6). Together, these findings indicate that the workstation configuration has an important role in overall performance, but that the change in performance due to configuration may be a factor only in long-duration missions or potentially for more complicated tasks than what was examined in the current study.

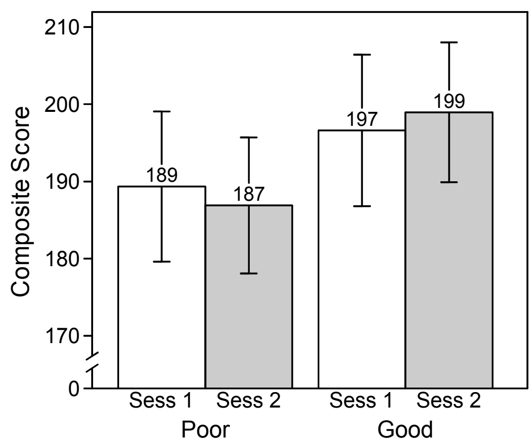

Figure 6: Multi-attribute task performance scores for the poor and good workstation configurations over the first and second 40-minute sessions

3.4 Cerebral Oxygen Saturation

Cerebral oxygenation levels of the right frontal lobes showed a significant increase in oxygenation in the good workstation configuration when compared to the poor configuration (p=0.0064). This trend follows the trend in the task performance scores (Figure 7). The values were representative of real-time regional percent oxygenation. Within configurations and sessions, the change from baseline was minimal. This indicates a physiologic response that may be directly related to performance and could potentially be used as a marker for the prediction of degradation.

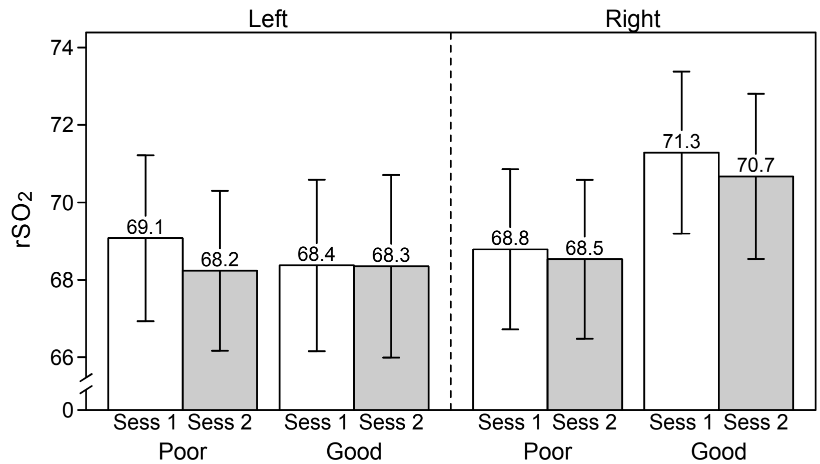

Figure 7: Regional oxygen saturation in the right and left frontal lobes for the poor and good workstation configurations over the first and second 40-minute sessions

4.0 DISCUSSION

Along with human factors issues, control station accommodation issues should be addressed as UAVs gain in popularity for Department of Defense missions. Due to the variations in sizes, not just of the individual as a whole but also of the bodily components within an individual, the only way to design for an ergonomically correct working environment is to allow for adjustability. When considering UAV control stations, in addition to static accommodation it is important to take into account action spaces which allow for realistic scenarios including control manipulation and multi-screen vigilance tactics. Although these action spaces should allow for maximal motion, there exist neutral positions within the space that will contain the majority of the action. Control stations should be designed such that the neutral position minimizes muscular fatigue and is subjectively comfortable to all potential users. In this study, the neutral position within the action spaces of the two workstation configurations was limited due to the simplicity of the control manipulation. However, this was necessary to understand the differences and the magnitudes of the effects that the good and poor workstation configuration would have on the operator physically, physiologically and cognitively.

This study showed a discrepancy between the objective measure of muscular fatigue and the subjective levels of perceived discomfort. As discussed briefly in the results, the fatigue that was evident in the deltoid muscle for the good workstation configuration was not present for the poor configuration. However, the perception of discomfort was much higher for the poor configuration for the shoulder, upper arms, neck and upper back. This was explainable from the posture restrictions placed on the subject. All subjects were asked to keep their wrist from resting on the keyboard platform because previous research has shown that the wrist should lay lightly on the mouse and not be anchored to the desk, especially to the sharp edge of the desk surface, in order to prevent such injuries as carpal tunnel syndrome. Subjects were instructed of this postural requirement at the start of every session for both the good and poor configurations. As shown in Figure 8 the subject maintained a neutral posture at the wrist at the start and end of the session for the good configuration, but there is an obvious shift in wrist posture where the forearm rests heavily at the wrist on the keyboard platform over time in the poor configuration. This shift in posture was representative of the majority of the subjects for the poor configuration. In such a scenario, the deltoid and the trapezius muscles may have been given periods of relief, but the trade-off would be high pressure at the wrist. However, the discomfort was still noted by the subjects, which may mean that other musculature was affected more so than those studied in the current effort.

The results indicate that workstation configuration indeed affects postural adaptation and muscular fatigue, subjective levels of discomfort, task performance and cerebral oxygenation. Even the short tasking time in this study affected the posture adaptation, muscular fatigue and discomfort. Operation time increases subjective levels of discomfort at a faster rate for the poorly accommodated workstation. During missions exceeding several hours in length, the physical effect of the control station could be further exacerbated and could lead to effects on the operator's cognitive performance. Regional cerebral oxygenation monitoring may be used as a potential predictor of performance degradation and should be further investigated.

For UAV control station designs, it is important to consider all sizes of potential users when designing for adjustability. In addition, designs must take into consideration the effect of synergistic positioning of all components of the workstation on all of the operator's body components. As demonstrated in this study, the cognitive implications of the mission will go hand-in-hand with the physical ergonomics, perhaps more noticeably for longer missions. Simply put, what needs constant attention must be easy to monitor and those controls that are used most often must be easy to reach and manipulate in order to maximize the operator's physical ability to perform the tasks and to sustain optimal performance.

Figure 8: Postural changes over time for the poor and good workstation configurations

5.0 REFERENCES

[1] Bone, E. and Bolkcom, C. (2003). Unmanned Aerial Vehicles: Background and Issues for Congress. *Report for Congress.* Congressional Research Service.

[2] Dixon, S., Wickens, C., and Chang, D. (2005). Mission control of multiple unmanned aerial vehicles: a workload analysis. *Human Factors.* 47(3):479-87.

[3] Draper, M. (2005). *Advanced UMV operator interfaces*. AFRL-HE-WP-TP-2005-0027, U.S. Air Force Research Laboratory, Human Effectiveness Directorate, Warfighter Interface Division, Wright-Patterson AFB, OH.

[4] Gawron, V.J. (1998). Human factors issues in the development, evaluation, and operation of uninhabited aerial vehicles. *AUVSI '98: The Proceedings of the Association for Unmanned Vehicle Systems International.* Huntsville, AL.

[5] Kraemer, J. (1977). Pressure dependent fluid shifts in the intervertebral disc. *Orthopaedic Clinics of North America.* 8:211-216.

[6] Cantoni, S., Colombini, D., Occhipinti, E., Frigo, E., Pedotti, A. (1984). Posture analysis and evaluation at the old and new workplace of a telephone company. *Ergonomics and Health in Modern Offices*. pp.456-464. Edited by Grandjean, E. Taylor & Francis. London.

[7] Grieco, A. and Molteni, G. (1999). Seating and Posture in VDT Work. *The Occupational Ergonomics Handbook.* pp. 1779-1791. Edited by Karwowski, W. and Marras, W. CRC Press.

[8] MIL-STD-1472F. (1999). *Human Engineering Design Criteria for Military Systems, Equipment and Facilities.* http://assist.daps.dla.mil/docimages/0001/87/31/milstd14.pd1.

[9] Blackwell, S., Robinette, K., Daanen, H., Boehmer, M., Fleming, S., Kelly, S., Brill, T., Hoeferlin, D., and Burnsides, D. (2002). *Civilian American and European Surface Anthropometry Resource (CAESAR), Final Report, Vol. II.* AFRL-HE-WP-TR-2002-0173, U.S. Air Force Research Laboratory, Human Effectiveness Directorate, Crew System Interface Division, Wright-Patterson AFB, OH.

[10] NIOSH. (1999). Occupational health aspects of work with video display terminals. *DHHS publication #99-135.*

[11] National Institute of Health. Ergonomics: Computer Workstations. *http://www.nih.gov/od/ors/ds/ergonomics/chair.html*.

[12] BSR/HFES 100. (2002). Human factors engineering of computer workstations. *Draft standard*.

[13] Centers for Disease Control. Computer workstation ergonomics. *http://www.cdc.gov/od/ohs/Ergonomics/compergo.htm*.

[14] Redfern, M.S. (1992). Functional Muscle: Effects on Electromyographic Output. *Selected Topics in Surface Electromyography for Use in the Occupational Setting: Expert Perspectives.* pp. 114-7. U.S. Department of Health and Human Services. Publication Number 91-100.

[15] Petrofsky, J.S. (1981). Quantification through the Surface EMG of Muscle Fatigue and Recovery during Successive Isometric Contractions. *Aviation, Space, and Environmental Medicine.* pp. 545-550.

[16] Christensen, H., Sogaard, K., Jensen, B., Finsen, L., and Sjogaard, G. (1995). Intramuscular and Surface EMG Power Spectrum from Dynamic and Static Contractions. *Journal of Electromyography and Kinesiology.* Vol 5(1). pp. 27-36.

[17] Stubbs, J., Pellettiere, J., and Pint, S. (2005). Quantitative Method for Determining Cushion Comfort. SAE Technical Paper 2005-01-1005. SAE Transactions: Journal of Passenger Cars, Society of Automotive Engineers, Warrendale, PA.

[18] Parakkat, J., Pellettiere, J., Reynolds, D., Sasidharan, M., El-Zoghbi, M. (2006). Quantitative Methods for Determining U.S. Air Force Crew Cushion Comfort. Society of Automotive Engineers. Paper Number 06DHM-45.

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05 October 11

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Donald Denio

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STINFO Officer
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